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AUTHORITY

ESD ltr, 6 Dec 1973

Project Report

PA-229-10
(RSP)

Data Reduction Program Documentation
ALCPOD

(Effective: May 1971)

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D. E. Nessman

19686

24 May 1971

Prepared for the Advanced Research Projects Agency, the Department of the Army, and the Department of the Air Force under Electronic Systems Division Contract F19628-70-C-0230 by

Lincoln Laboratory
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Lexington, Massachusetts

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

LINCOLN LABORATORY

DATA REDUCTION PROGRAM DOCUMENTATION ALCPOD1 (EFFECTIVE: MAY 1971),

C. R. BERNDTSON
~~Group 92~~

R. H. FRENCH
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Philco-Ford Corporation
Editors

PA-229-10

PROJECT REPORT PA-229-10 (RSP)

24 MAY 1971

50p.

F19628-70-C-0230,
ARPA Order-600

LEXINGTON

L. G. Hanscom Field
Bedford, Mass. 01730

MASSACHUSETTS

The work reported in this document was performed at Lincoln Laboratory, a center for research operated by Massachusetts Institute of Technology. This work was sponsored by the Advanced Research Projects Agency of the Department of Defense (ARPA Order 600), the Department of the Army, and the Department of the Air Force under Air Force Contract F19628-70-C-0230.

FOREWORD

This is the tenth report in the Data Reduction Program Documentation series. It is dated according to the date of completion of the documentation. No implication is made that this program will not subsequently be modified, amended, or superseded; on the contrary, the history of radar data processing is one of continuous evolution of techniques, and it is unrealistic to assume that steady-state has been reached.

The preparation of reports in this series is under the Editorship of Charles R. Berndtson of Lincoln, and of D. Nessman and R. French of Philco-Ford Corporation. Inquiries, suggestions, corrections, criticisms, and requests for additional copies should be directed to C. R. Berndtson.

The principal contributor to this report was G. L. Shapiro (Philco-Ford). Due to the intricate, evolutionary manner in which the programs came into being, the editors regret that it is in general impossible to give due credit to all -- mathematicians or radar analysts or programmers -- who contributed to the definition and writing of the programs.

Alan A. Grometstein

CONTENTS

CONTENTS (cont'd)

COMMON SYMBOLS AND ABBREVIATIONS

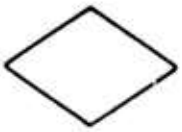
(The units given for certain quantities are the units commonly used for those quantities, unless otherwise noted.)

ADT	ALCOR Data Tape
ALCOR	ARPA-Lincoln C-band Observables Radar
ALTAIR	ARPA Long-Range Tracking and Instrumentation Radar
Alt	Altitude (km)
APS	Average Pulse Shape
ARS	ALTAIR Recording System
Avg	Average, Averaging
Az	Azimuth (deg)
c	Speed of Light
CADJ	Adjusted Calibration Constant (db)
C-band	ALCOR frequency, 5664 MHz (NB) and 5667 MHz (WB)
DBLT	Wide Band Pulse Doublet
El	Elevation (deg)
EOF	End of File
GMT	Greenwich Mean Time
h	Hours
Hz	Hertz
IF	Intermediate Frequency
in	Inches
LC	Left Circular Polarization
lsb	Least Significant Bit
min	Minutes
NB	Narrow Band
NRTPOD	Non-real Time Precision Orbit Determination Program
POD	Project PRESS Operation and Data Summary Report
Phase	Presented in deg
PRF	Pulse Repetition Frequency (pps)
PRI	Pulse Repetition Interval (s)
pps	Pulses per second
pts	Points

$\dot{R}$	Range (km)
$\dot{R}$	Range Rate (km/s)
rad	Radians
RC	Right Circular Polarization
RCS	Radar Cross Section (dbsm)
RF	Radio Frequency
s	Seconds
SD_w	Standard Deviation of Wake Velocity
SDBLT	Wide Band Slaved Pulse Doublet
S/N	Signal-to-noise Ratio
T	Time
TAL	Time After Launch (s)
UHF	ALTAIR Frequency; 415 MHz
V	Velocity
V_d	Doppler Velocity
V_w	Mean Wake Velocity
VHF	ALTAIR Frequency; 155.5 MHz
WB	Wide Band
WBS	Wide Band Slaved
WTR	Western Test Range
θ	Total Off-axis Angle (deg)
λ	Wavelength
*	Denotes Multiplication

FLOW DIAGRAM SYMBOLS

PROCESS, ANNOTATION



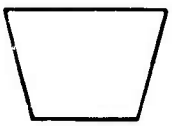
DECISION

TERMINATOR

SUBROUTINE: where NAME is the entry call into the subroutine

CONNECTOR: where P specifies a page in the flow diagram, and L designates a statement number in the program listing or a reference point in the flow diagram

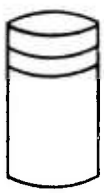
CONNECTOR: where X implies a continuation of the diagram to the next page



INPUT/OUTPUT OPERATION

MAGNETIC TAPE

PUNCHED CARD



DISK

ALCPOD

1. PURPOSE AND UTILIZATION

A. Source of Data

ALCOR[1]

B. Data Input

ALCOR Data Tape (ADT)

C. Description

ALCPOD is designed to produce punched card metric data on hard body radar targets in a format suitable for input to ~~NRTPOD~~. The data are ultimately used to obtain a ~~β~~ Beta profile. ALCPOD is normally run every 0.1 s without smoothing.

D. Output

1. A listing of all computed quantities.
2. Punched cards containing corrected R, Az, and El in a format suitable for input to NRTPOD. (Optional: smoothed $\dot{R}$.)

NRTPOD (non-real time precision orbit determination program).

from page 1

II. DESCRIPTION

ALCPOD produces punched metric data for input to NRTPOD. The program processes either ~~NB~~ narrowband or ~~WB~~ wideband tapes, and uses only primary pulses. The time between cards is determined by NSKIP, the number of primary pulses between output samples. Therefore, the sampling rate changes as the PRF changes.

GMT (h, min, s) is derived from one of three sources:

a. The transmitted pulse time (accurate to 10 μs) from tape.

b. Calculated time using the PRI and the received time of the initial pulse (accurate to 1 ms).

c. The received pulse time (accurate to 1 ms) from tape.

R, Az, and El are corrected as follows:

$$R = IRANGE + TRBIAS + TTCOR + RRCOR - RCORF$$

$$Az = IAZ + AZBIAS$$

$$El = IEL + ELBIAS - ECORF$$

where

IRANGE is uncorrected R

TRBIAS is range bias

TTCOR (transmit time correction) = $R\dot{R}/c$

RRCOR is range doppler coupling correction

RCORF is tropospheric refraction correction

IAZ is Az encoder angle

AZBIAS is Az bias (Calibration Record Word 602)

IEL is El encoder angle

ELBIAS is El bias (Calibration Record Word 603)

ECORF is tropospheric refraction correction

$\dot{R}$, if requested, is computed:

$$\dot{R}(t) = \frac{12 \sum_{n=1}^{N} [nR(t + n\Delta t) - nR(t - n\Delta t)]}{(\Delta t)(2N + 1)[(2N + 1)^2 - 1]}$$

where

$\dot{R}(t)$ = Range rate at time t

N = No. of points in a half interval

$R(t + n\Delta t)$ = Range at time $(t + n\Delta t)$

Δt = time between consecutive range samples; i.e. 1/(primary pulse PRF)

Before processing, the main program checks that ITBAND (tape) = IBAND (input). This determines that if WB data is requested, WB data exists on the tape requested.

III. OPERATION

A. Input

Waveform

Time of pulse option

$\dot{R}$ option

No. of pulses in smoothing half interval

Skip interval (pulses)

First and last pulse nos. of processing intervals

No. of processing intervals

A sample input is shown in Appendix A.

CARD 1 (5I5, 2X, A3)

(Col.)		
1- 5	NBAND	0 = NB; 1 = WB
6-10	ITLUSE[#]	0 = transmitted pulse time accurate to 10 μs (0) 1 = calculated pulse time accurate to 1 ms 2 = received pulse time accurate to 1 ms
11-15	NVALS	No. of processing intervals
16-20	NINT[#]	0 = $\dot{R}$ on cards (0) 1 = no $\dot{R}$ on cards
21-25	NSMTH[#]	No. of pulses in smoothing half interval (5)
28-30	TITL[#]	3 character title (ALC)

CARD 2 (6I10)

(Col.)		
1-10	NSTART(1)	First pulse no. of initial processing interval
11-20	NSTOP(1)	Last pulse no. of initial processing interval
21-30	NSKIP(1)	No. of pulses to skip between each output card
31-40	NSTART(2)	First pulse no. of second processing interval

[#] If left blank, program sets to indicated value.

(Col.)

41-50	NSTOP(2)	Last pulse no. of second processing interval
51-60	NSKIP(2)	No. of pulses to skip between each output card

Repeat card 2 as necessary.

B. Output

LISTING

Selected input parameters

GMT h, min, s, and ms

R, $\dot{R}$, Az, El, and pulse no.

PUNCHED CARDS

Radar identification (A3)

Year (3X, I2)

Month (I2)

Day (I2)

h (I2)

min (I2)

s (I2)

fraction of second (I3, 3X) or (I5, 1X)#

Orbit no. (I1)

Az (F8.3)

El (4X, F8.3)

R (4X, F12.4)

$\dot{R}$ (if requested) (5X, F8.5)

Sample outputs are given in Appendix B.

(I5, 1X) if ITLUSE = 0; (I3, 3X) if ITLUSE = 1 or 2

IV. PROGRAM LIMITATIONS

NVALS	$\leq$ 50 processing intervals
Length of run	If $\dot{R}$ is desired, no. of pulses $\leq$ 4000 If $\dot{R}$ is not desired, no limit

If $\dot{R}$ is requested (NINT = 0), a processing interval should not contain a PRF change. Program processes primary pulses only.

V. PROGRAMMING

A. ALCPOD (see Appendices C and D.)

ALCPOD is the control section of ALCPOD. ALCPOD reads the input cards, calls READJS and UNPACK, and punches the desired metric data.

B. HEDADT (see Appendix E.)

Subroutine HEDADT unpacks the ADT header record which contains bandwidth, reel no., WTR no., data of mission, and mission designator. The call statement is HEDADT [ISIG,[#] INBUF(1), IEQM(1)]

INPUT

INBUF(1)	First word in the ADT header record[##]

OUTPUT

IEQM(1)	IZBAND	(bandwidth: 1=WB, 0=NB)
IEQM(2)	ITREEL	(reel no.)
IEQM(3)	ITWTR	(WTR no.)
IEQM(4)	IMTH	
IEQM(5)	IDAY	(Date of test)
IEQM(6)	IYR	
IEQM(7-9)	ITDESG	(mission designator)

C. UNPACK (see Appendix F.)[2]

Subroutine UNPACK unpacks the raw data from the ADT, and translates it into a format usable by the IBM 360/67 computer.

[#] Not used.

[##] INBUF(2) to INBUF (1803) contain the remaining words in the record.

D. READJS[2]

The first call to subroutine READJS opens the file and reads the ADT header record. The second call to READJS reads the ADT calibration record and stores the values in a buffer area. ALCPOD extracts the individual calibration values it requires. Each subsequent call to READJS reads an ADT data record consisting of eight ALCOR pulses.

E. TIMDP (see Appendix G.)

TIMDP converts GMT total s to h, min, s, and μs.

The call statement is TIMDP (TIME, IHR, MIN, ISEC, IFRAC).

INPUT

TIME	Time of pulse transmission (GMT total seconds in double precision)

OUTPUT

IHR	Hours
MIN	Minutes
ISEC	Seconds
IFRAC	μs

F. SMOOTH (see Appendix H.)

Subroutine SMOOTH computes $\dot{R}$ using the original R and T.

The call statement is SMOOTH (N, L, X, NO, ZH).

INPUT

N	No. of points in smoothing half interval
L	No. of pulses within all processing intervals
X	Array of Ranges

NO Code specifying operation desired. Set to zero to obtain $\dot{R}$.

ZH Time (s) between range samples (1/primary pulse PRF)

STORED IN COMMON

RR Array of $\dot{R}$

G. DREFC (see Appendix J.)

The tropospheric refraction correction subroutine, DREFC, is based on tropospheric refraction tables in PPP-36.[3] A modified version of this subroutine is now in use. DREFC is the same as REFC except that the values or constants are defined as double precision words.

The call statement is DREFC (E, R, DEE, DRR).

E = Uncorrected El (must be between 0° and 90°)

R = Uncorrected R (km)

DEE = El tropospheric correction

DRR = R tropospheric correction (km)

The corrected values to be computed after exiting from the DREFC subroutine are:

El = E-DEE

R(km) = R-DRR

REFERENCES

1. "ALCOR Data Users Manual", LM-86, Lincoln Laboratory, M.I.T. (17 June 1970), UNCLASSIFIED.

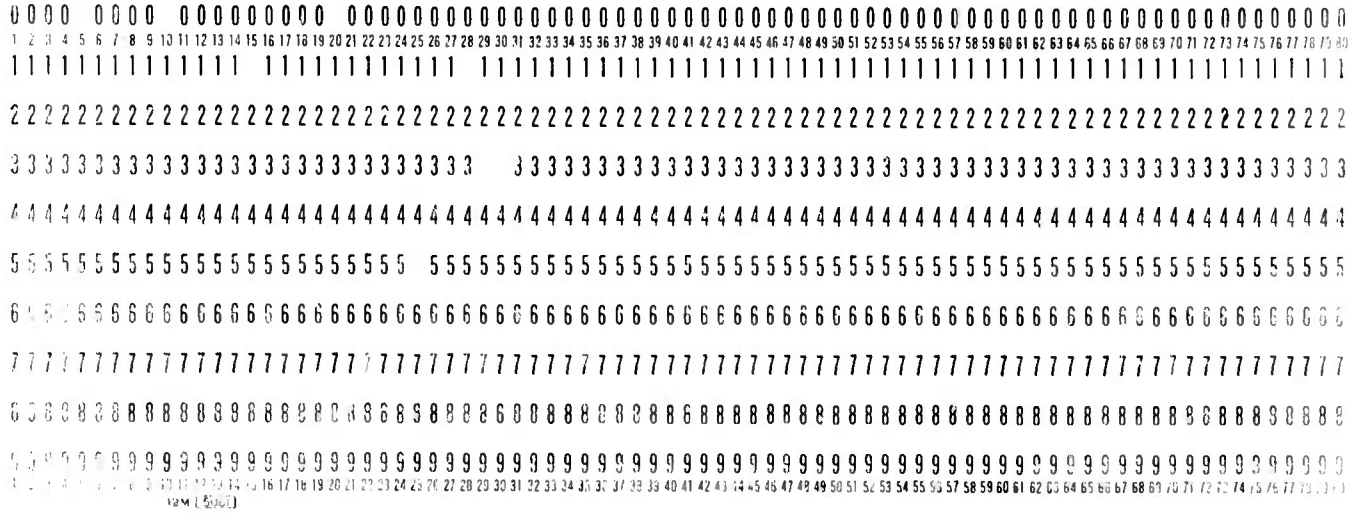
2. "Data Reduction Program Documentation, ALCOR Tape Read Package, (Effective: April 1971)", PA-229-7, Lincoln Laboratory, M.I.T. (26 April 1971), UNCLASSIFIED.

3. J. P. Penhune, "Refraction Corrections for the TRADEX Radar", PPP-36 Lincoln Laboratory, M.I.T. (21 April 1965), UNCLASSIFIED.

APPENDIX A
ALCPOD INPUT

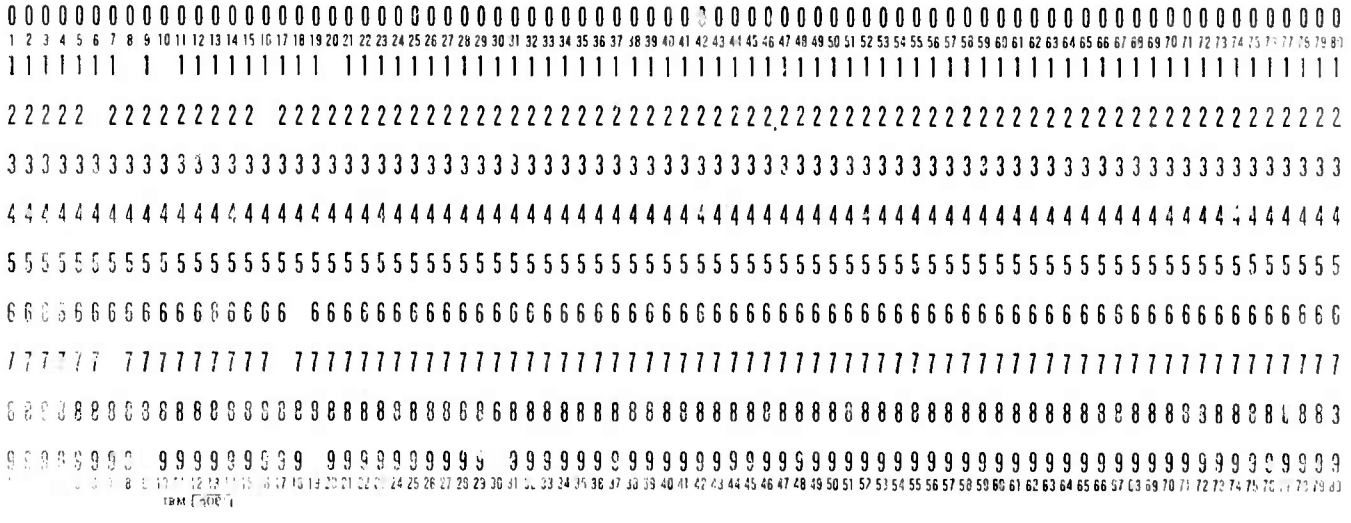
```
0    0    1    0    5 ALC
```

CARD 1



```
27191      27691          9
```

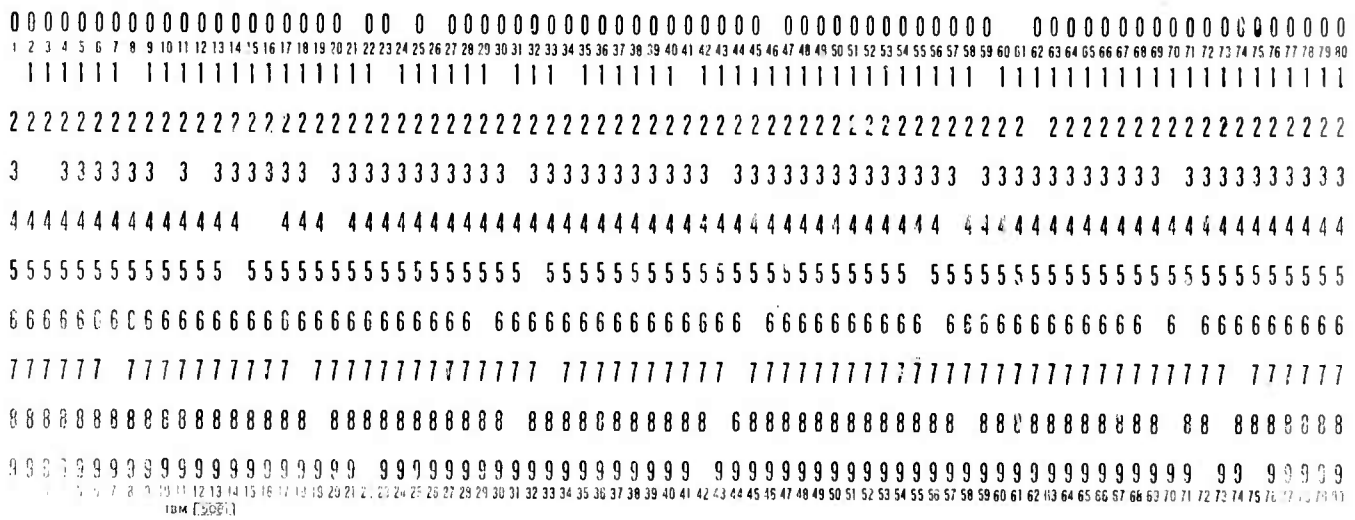
CARD 2



APPENDIX B
ALCPOD OUTPUTS

```
POD-ALCOR   POLAR = LC     BANO = NB     REEL NO. =     2    TITLE = ALC     DATE =  3/ 3/71
     ITLOSE =   0

 START   STOP   SKIP          START   STOP   SKIP          START   STOP   SKIP          START   STOP   SKIP
 27191   27691     9

ITLUSE = 0 : USE GMT AS COMPUTED BY DOUBLE PREC.WORDS ON TAPE ((TR-TT)/2)
ITLUSE = 1 : USE GMT AS COMPUTED BYPROGRAM AS A FUNCTION OF PRF (TIME OF RECEPTION)
ITLUSE = 2 : USE GMT AS COMPUTED BY REGULAR GMT WORDS (TIME OF RECEPTION)


NINT = 0 (SMOOTHING IS TO OCCUR)
NO. OF POINTS ON EACH SIDE OF INTERPOLATED POINT =     5

READY TO SMOOTH    501   POINTS WITH A DELTA TIME(SEC) =  0.010  THEN PUNCH EVERY      10

TITLE    DATE H M S  MS       AZI(DEG)      ELI(DEG)       RANGE(KM)     ROOT(KM/S)

ALC    71 3 3 544 7.30910 0   61.560        19.748         564.7701       0.00017     27191
ALC    71 3 3 544 7.40910 0   61.571        19.760         564.1002      -6.69879     27201
ALC    71 3 3 544 7.50910 0   61.576        19.762         563.4317      -6.68640     27211
ALC    71 3 3 544 7.60910 0   61.587        19.768         562.7604      -6.71191     27221
ALC    71 3 3 544 7.70909 0   61.595        19.768         562.0908      -6.69662     27231
ALC    71 3 3 544 7.80909 0   61.604        19.771         561.4219      -6.69025     27241
ALC    71 3 3 544 7.90909 0   61.606        19.773         560.7525      -6.69463     27251
ALC    71 3 3 544 8.  909 0   61.609        19.782         560.0829      -6.69636     27261
ALC    71 3 3 544 8.10908 0   61.612        19.784         559.4137      -6.69297     27271
ALC    71 3 3 544 8.20908 0   61.615        19.790         558.7438      -6.69912     27281
ALC    71 3 3 544 8.30908 0   61.620        19.793         558.0742      -6.69620     27291
ALC    71 3 3 544 8.40908 0   61.623        19.795         557.4044      -6.69765     27301
ALC    71 3 3 544 8.50907 0   61.626        19.801         556.7347      -6.69745     27311
ALC    71 3 3 544 8.60907 0   61.628        19.804         556.0646      -6.70117     27321
ALC    71 3 3 544 8.70907 0   61.631        19.806         555.3947      -6.69925     27331
ALC    71 3 3 544 8.80907 0   61.634        19.815         554.7248      -6.69947     27341
ALC    71 3 3 544 8.90907 0   61.637        19.817         554.0548      -6.69996     27351
ALC    71 3 3 544 9.  906 0   61.642        19.826         553.3846      -6.70181     27361
ALC    71 3 3 544 9.10906 0   61.648        19.828         552.7147      -6.69980     27371
ALC    71 3 3 544 9.20906 0   61.648        19.837         552.0448      -6.69852     27381
ALC    71 3 3 544 9.30906 0   61.650        19.839         551.3747      -6.70182     27391
ALC    71 3 3 544 9.40905 0   61.659        19.845         550.7046      -6.70105     27401
ALC    71 3 3 544 9.50905 0   61.661        19.848         550.0344      -6.70179     27411
ALC    71 3 3 544 9.60905 0   61.664        19.850         549.3641      -6.70333     27421
ALC    71 3 3 544 9.70905 0   61.670        19.856         548.6939      -6.70243     27431
ALC    71 3 3 544 9.80904 0   61.672        19.862         548.0236      -6.70257     27441
ALC    71 3 3 544 9.90904 0   61.678        19.867         547.3531      -6.70484     27451
ALC    71 3 3 54410.  904 0   61.683        19.873         546.6828      -6.70332     27461
ALC    71 3 3 54410.10904 0   61.692        19.881         546.0125      -6.70382     27471
ALC    71 3 3 54410.20904 0   61.694        19.884         545.3415      -6.70907     27481
ALC    71 3 3 54410.30903 0   61.697        19.889         544.6710      -6.70542     27491
ALC    71 3 3 54410.40903 0   61.703        19.892         544.0005      -6.70482     27501
ALC    71 3 3 54410.50903 0   61.708        19.897         543.3300      -6.70529     27511
ALC    71 3 3 54410.60903 0   61.714        19.903         542.6587      -6.71180     27521
ALC    71 3 3 54410.70902 0   61.716        19.906         541.9881      -6.70636     27531
ALC    71 3 3 54410.80902 0   61.719        19.911         541.3177      -6.70463     27541
ALC    71 3 3 54410.90902 0   61.725        19.914         540.6470      -6.70724     27551
ALC    71 3 3 54411.  902 0   61.730        19.922         539.9763      -6.70721     27561
ALC    71 3 3 54411.10901 0   61.735        19.925         539.3056      -6.70743     27571
ALC    71 3 3 54411.20901 0   61.738        19.930         538.6348      -6.70739     27581
ALC    71 3 3 54411.30901 0   61.741        19.936         537.9641      -6.70793     27591
ALC    71 3 3 54411.40901 0   61.746        19.939         537.2932      -6.70872     27601
ALC    71 3 3 54411.50900 0   61.752        19.944         536.6224      -6.70855     27611
```

ALC 71 3 3 544 7.40910 0 61.571 19.760 564.1002 -6.69879



APPENDIX C
ALCPOD PROGRAM LISTING

```
      DOUBLE PRECISION RDOT,DTRB,RANGE,TTCOR,DRRUSE,RRCOR,ZZ,XAZ,DAZB,
     1ZL,XEL,DELB,RNGF,ELVF,RADEL,ECORF,RCORF,XDPTIM
      REAL*8 RANG,RR
      DIMENSION IYEAR(4000),MONTH(4000) ,IDAY(4000),IHOUR(4000),
     1 MIN(4000),ISEC1(4000),ISEC2(4000),            AZ(4000),EL(4000),
     2 RANG(4000),RR(4000),ISPRI(4000)
      DIMENSION NSTART(50),NSTOP(50),NSKIP(50)
      DIMENSION XATBL(128),QBIAS(8),IPRS(8),IADD(8)
      DIMENSION XNBUF(1803),PIFA(16),OIFA(16),        XKPCS(5)
      DIMENSION IEQM(9),ITDESG(3)
C
      COMMON RR
      COMMON/ICOM/INBUF(1803),IAZ,IEL,INDEX,IPPRCS,IORS,IRANGE,IPKPWR,IR
     1DOT,IALT,INDAZ,JNDAZ,INDEL,IRB54,IRB85,IOPRCS,I240B1,I240B2,I240B3
     1,I241B1,I241B2,I241B3,XPPAGC,IBETA,NEWA,IBAND,NSW,RBIAS(8),ISVPRI,
     1IHRS,IMIN,ISEC,IMSEC,ISTAT(21),TRBIAS,ISTAT1,ISTAT2,ISTAT3,ISTAT4,
     1IALSW,ISTSW,NBWB,ISIGNC,I27B12,JCON,NBEG,NEND,ITST,NUMPRI,XOPAGC,
     1ITBAND,ITAPNC,IPRF,IPOLAR,ISSERR,PIFA,CIFA,PFSA,OFSA,PSSA,CSSA,
     1PSSL,OSSL,ICCDF,I273B5,I273B6,I273B7,I273B8,IMOVP,IMCVC,IOFFST,
     1XDPTIM,IDAT(682)
C
      EQUIVALENCE(XNBUF(1),INBUF(1))
      EQUIVALENCE (IEQM(1),IZBAND),(IEQM(2),ITREEL),(IEQM(3),ITWTR),
     2(IEQM(4) ,ITMNTH),(IEQM(5),ITDAY),(IEQM(6),ITYEAR),
     3(IEQM(7),ITDESG(1))
C
      DATA ZLC/'LC  '/,ZRC/'RC  '/,ZWB/'WB  '/,ZNB/'NB  '/ ,NTCT/0/
      DATA         IFRST3/0/,IFRST4/0/,INTAV/1/,IFRST2/0/
      DATA ALC/'ALC'/,ION/1/,IZERO/0/,IFRST1/0/,IMSAVE/0/,BLNKK/'    '/
      DATA IPRS/200,160,100,80,50,40,25,20/
      DATA IADD/10,13,10,13,20,25,40,50/
C
C        IPOLAR = 0 LEFT CIRCULAR DATA REQUESTED
C        IPOLAR = 1 RIGHT CIRCULAR DATA REQUESTED
C        NBAND = 0  NARROW BAND DATA REQUESTED
C        NBAND = 1  WIDE BAND DATA REQUESTED
C        ITLUSE = 0   USE GMT AS COMPUTED BY DOUB.PREC.TP.WD.((TR-TT)/2)
C        ITLUSE = 1   USE GMT AS COMPUTED BY PRF IN PROGRAM (TR)
C        ITLUSE = 2   USE GMT AS COMPUTED BY REGULAR GMT WORDS  (TR)
C        NEWA = 0   MISSION FLOWN BEFORE 15 OCT 70 (OLD ATTN.)
C        NEWA = 1   MISSION FLOWN AFTER  15 OCT 70 (NEW ATTN.)
C        NINT = 0 SMOOTHING IS DONE
C        NINT = 1 NO SMOOTHING
C
      READ(5,1)NBAND,ITLUSE,NVALS,NINT,NSMOO1,TITL,
     2(NSTART(I),NSTOP(I),NSKIP(I),I=1,NVALS)
    1 FORMAT(5I5,      2X,A3/(6I10))
      IF(NSMOO1.LE.0)NSMOO1=5
```

```
      NSMOO=NSMOO1
      MSVE=NSKIP(1)
      IF(TITL.NE.BLNKK)ALC=TITL
      NSW=ITLUSE
C
      IEOF=0
      IERR=0
      CALL READJS(INBUF,IEOF,IERR)
      ISIG=1
      CALL HEDADT (ISIG,INBUF(1),IEGM(1))
      ITBAND=IZBAND
      NEWA=0
      IF(ITYEAR.GT.70)GO TO 282
      IF(ITYEAR.LT.70)GO TO 283
      IF(ITMNTH.GT.10)GO TO 282
      IF(ITMNTH.LT.10)GO TO 283
      IF(ITDAY.LT.15)GO TO 283
  282 NEWA=1
  283 CONTINUE
      IERR=0
      CALL READJS(INBUF,IEOF,IERR)
C
C        STORE THE DESIRED CALIBRATION VALUES
C
      N=0
      DO 20 K=256,387
      N=N+1
   20 XATBL(N)=XNBUF(K)
C
      N=0
      DO 22 K=512,527
      N=N+1
   22 PIFA(N)=XNBUF(K)
      N=0
      DO 23 K=528,543
      N=N+1
   23 OIFA(N)=XNBUF(K)
C
      PFSA=XNBUF(592)
      PSSA=XNBUF(593)
      OFSA=XNBUF(594)
      OSSA=XNBUF(595)
C
      ABIAS=XNBUF(602)
      EBIAS=XNBUF(603)
      DEGCON=(180.*.0479369)/3141.59
      AZBIAS=DEGCON*ABIAS
      ELBIAS=DEGCON*EBIAS
C
      N=0
      DO 25 K=604,611
      N=N+1
      QBIAS(N)=XNBUF(K)
   25 RBIAS(N)=QBIAS(N)
C
      PWRCN=XNBUF(620)
      PWRSN=XNBUF(621)
```

```
      PWRCW=XNBUF(627)
      PWRSW=XNBUF(628)
C
      N=0
      DO 27 K=624,628
      N=N+1
   27 XKRCS(N)=XNBUF(K)
C
      PSSL=XNBUF(629)
      OSSL=XNBUF(630)
C
      JCON=-1
      INDEX=0
      ITST=1
      ITDEC=1
      IPOLAR=0
      ITCNT=0
      JJ=0
      IPULS=0
C
      DO 120 IJ=1,NVALS
      NBEG=NSTART(IJ)
C
      NNSET=NSKIP(IJ)+1
      IF(NINT.EQ.0)NNSET=1
C
    3 JCON=JCON+1
      IF(JCON.EQ.9.OR.JCON.EQ.0)GO TO 97
      INDEX=(JCON-1)*900
      GO TO 99
   97 JCON=1
      INDEX=0
   98 IEOF=0
      IERR=0
      CALL READJS(INBUF,IEOF,IERR)
      IF(IERR.EQ.1)GO TO 103
   99 CALL UNPACK
      IF(ICODE.EQ.3.OR.ICODE.EQ.7.OR.ICODE.EQ.2)GO TO 620
      IF(ITLUSE.NE.0)GO TO 100
      CALL TIMDP(XDPTIM,IHRS,IMIN,ISEC,IMSEC)
  100 CONTINUE
      IF(IFRST2.EQ.1)GO TO 92
      ZBAN=ZNB
      IF(ITBAND.EQ.1)ZBAN=ZWB
      ZPOL=ZLC
      IF(IPOLAR.EQ.1)ZPOL=ZRC
      RRUSE=-.00943
      IF(ITBAND.EQ.1)RRUSE=-.000115
C
      WRITE(6,200)ZPOL,ZBAN,ITREEL,TITL,(IEQP(I),I=4,6)
  200 FORMAT('1POD-ALCOR   POLAR = ',A2,4X,'BAND = ',A2,4X,'REEL NO. = '
     1,I5,'   TITLE = ',A4,'   DATE = ',I2,'/',I2,'/',I2)
      WRITE(6,208) ITLUSE
208   FORMAT('       ITLUSE = ',I3)
      WRITE(6,212)(NSTART(I),NSTOP(I),NSKIP(I),I=1,NVALS)
212   FORMAT('0 START   STOP   SKIP',10X,'START   STOP   SKIP',10X,
     1 'START   STOP   SKIP',10X,'START   STOP   SKIP'/
```

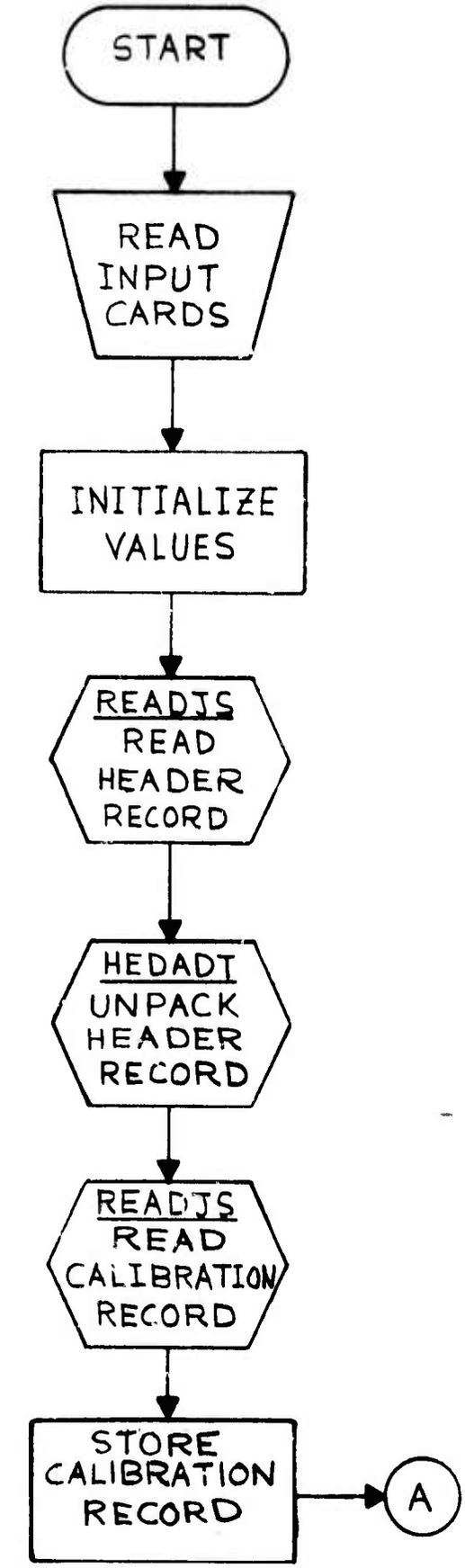
```
     2 (4(2X,I5,2X,I5,2X,I5,8X)))
       WRITE(6,201)
  201 FORMAT('0ITLUSE = 0 0 USE GMT AS COMPUTED BY DOUBLE PREC.WORDS ON
     1TAPE ((TR-TT)/2)           '/' ITLUSE = 1 0 USE GMT AS COMPUTED BY
     2PROGRAM AS A FUNCTION OF PRF (TIME OF RECEPTION)'/' ITLUSE = 2 0 U
     3SE GMT AS COMPUTED BY REGULAR GMT WORDS (TIME OF RECEPTION) '/)
       IF(NINT.NE.0)GO TO 218
       WRITE(6,214)     NSMOO
  214 FORMAT('0NINT = 0 (SMOOTHING IS TO OCCUR)'/ 1X,'NO. OF POINTS ON E
     1ACH SIDE OF INTERPOLATED POINT = ',I4)
  218 CONTINUE
C
       IF(NBAND.NE.ITBAND)GO TO 695
       IFRST2=1
   92  CONTINUE
       IF(ITLUSE.NE.1)GO TO 619
       IF(NUMPRI.LT.NSTART(IJ))GO TO 616
       IF(IFRST1.EQ.1)GO TO 617
       IADMS=0
       DO 612 K=1,8
  612  IF(IPRS(K).EQ.IPRF)IADMS=IADD(K)
       IF(IADMS.GT.0)GO TO 602
  599  WRITE(6,601)NUMPRI,IPRF
  601  FORMAT('0',12X,'UNKNOWN PRF',3X,'PRI. NO = ',I10,5X,'PRF = ',I5/)
       IF(NINT.EQ.0)GO TO 121
       GO TO 125
C
  602  IHNEXT=IHRS
       INNEXT=IMIN
       ISNEXT=ISEC
  584  IMNEXT=IMSEC +IADMS
C
       IF(IMNEXT.LT.1000)GO TO 585
       IMNEXT=IMNEXT-1000
       ISNEXT=ISNEXT+1
C
       IF(ISNEXT.LT.60)GO TO 585
       ISNEXT=ISNEXT-60
       INNEXT=INNEXT+1
C
       IF(INNEXT.LT.60)GO TO 585
       INNEXT=INNEXT-60
       IHNEXT=IHNEXT+1
C
  585  IFRST1=1
       GO TO 616
  617  IADMS=0
       DO 613 K=1,8
       IF(IPRS(K).EQ.IPRF)IADMS=IADD(K)
  613  CONTINUE
       IF(IADMS.LE.0)GO TO 599
  586  IHRS=IHNEXT
       IMIN=INNEXT
       ISEC=ISNEXT
       IMSEC=IMNEXT
       IMNEXT=IMSEC +IADMS
       IF(IMNEXT.LT.1000)GO TO 616
```

```
      IMNEXT=IMNEXT-1000
      ISNEXT=ISNEXT+1
C
      IF(ISNEXT.LT.60)GO TO 616
      ISNEXT=ISNEXT-60
      INNEXT=INNEXT+1
C
      IF(INNEXT.LT.60)GO TO 616
      INNEXT=INNEXT-60
      IHNEXT=IHNEXT+1
C
  616 CONTINUE
  619 CONTINUE
C
  620 IF(NUMPRI.LT.NSTART(IJ))GO TO 3
      IF(NUMPRI.GT.NSTART(IJ))GO TO 628
      IF(ICODE.EQ.3.OR.ICODE.EQ.7.OR.ICODE.EQ.2)GO TO 600
      GO TO 627
  600 NSTART(IJ)=NSTART(IJ)+1
      WRITE(6,6314)IJ,NSTART(IJ)
 6314 FORMAT('ONSTART(',I3,') HAS BEEN CHANGED TO ',I10)
      GO TO 3
  627 IPULS=0
      GO TO 10
  628 IF(ICODE.EQ.3.OR.ICODE.EQ.7.OR.ICODE.EQ.2)GO TO 118
      IPULS=IPULS+1
      IF(IPULS.NE.NNSET)GO TO 118
      IPULS=0
C
   10 CONTINUE
      IF(IFRST4.NE.0)GO TO 11
      DTIME=(1./FLOAT(IPRF))
      IFRST4=1
   11 RDOT=(DFLOAT(IPDCT)/(8192.0D+00))*14.989625D+00
      RZOT=RDOT/1000.
      DTRB=TRBIAS
      RANGE=(DFLOAT(IRANGE)/2048000.D+00)*14.989625D+00+DTRB*.1498962500
      IF(ITLUSE.NE.0)GO TO 663
      IDELTM=(RANGE/299776.D+00)*1.0D+06
      IMSEC=DFLOAT(IMSEC+IDELTM)/10.0D+00+.50+00
      IF(IMSEC.LT.100000)GO TO 641
      IMSEC=IMSEC-100000
      ISEC=ISEC+1
      IF(ISEC.LT.60)GO TO 641
      ISEC=ISEC-60
      IMIN=IMIN+1
  641 CONTINUE
      GO TO 664
  663 TTCOR=(RANGE/299776.D+00)*(RDOT/1000.0D+00)
      RANGE=RANGE+TTCOR
  664 CONTINUE
      DRRUSE=RRUSE
      RRCOR=DRRUSE*RDOT
      RANGE=RANGE+RRCOR/1000.D+00
      ZZ=(DFLOAT(IAZ)*2.D+00*3141.5926535D+00)/(2.0D+00**17)
      XAZ=ZZ*.057295RD+00
      DAZB=AZBIAS
```

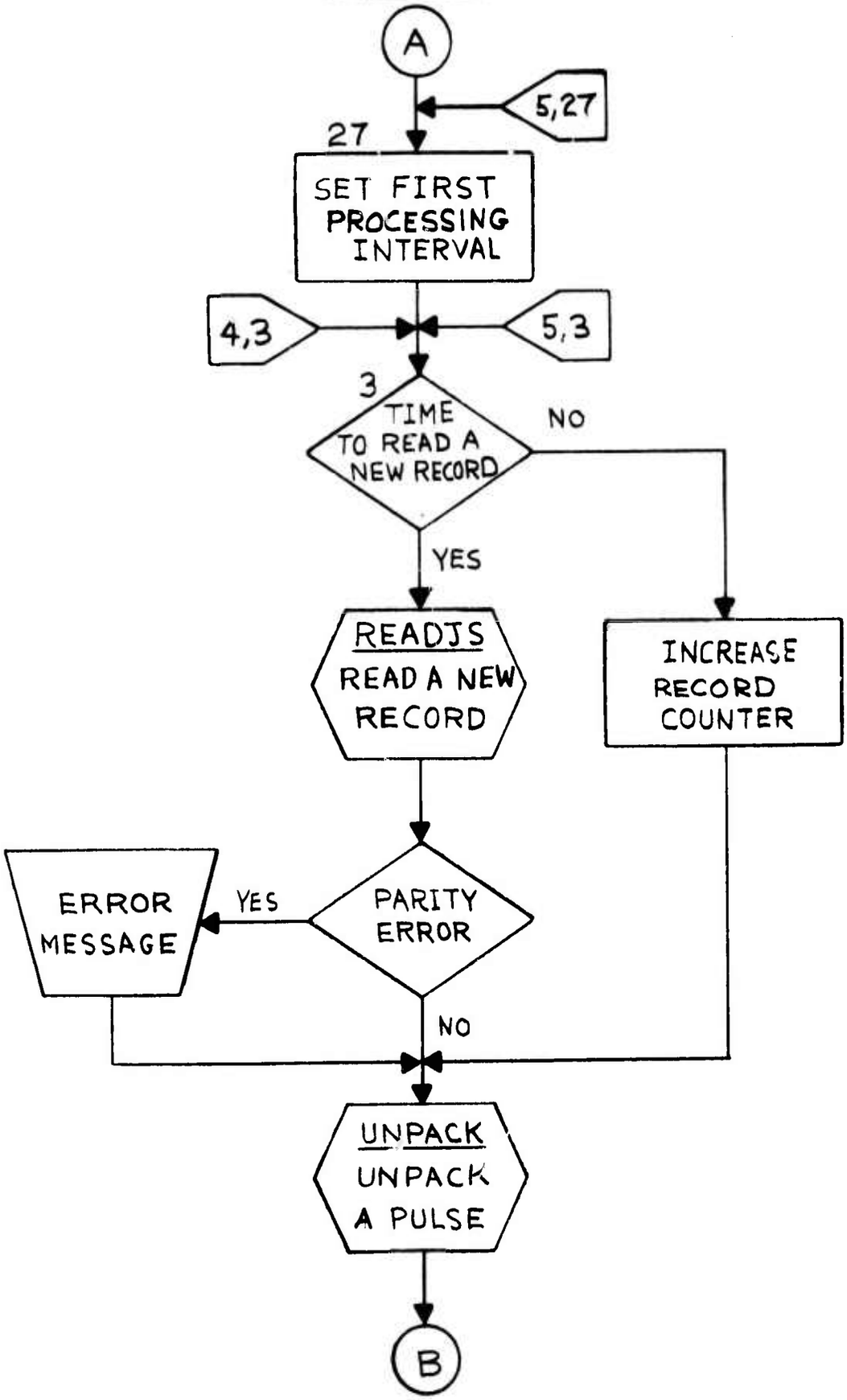
```
      XAZ=XAZ+DAZB
      ZL=(DFLOAT(IEL)*2.D+00*3141.5926535D+00)/(2.0D+00**17)
      XEL=ZL*.0572958D+00
      DELB=ELBIAS
      XEL=XEL+DELB
      CALL DREFC (XEL,RANGE,ECORF,RCORF)
      RNGF=RANGE-RCORF
      ELVF=XEL-ECORF
      RADEL=ELVF*.017453D+00
      RANGE=RNGF
C
      IF(NINT.EQ.0)ION=0
      IF(ION.EQ.1)WRITE(6,647)
  647 FORMAT('0TITLE   DATE H M S  MS      AZ(DEG)      EL(DEG)        RANG
     1E(KM)   RDOT(KM/S)'/)
      ION=0
      IF(NINT.NE.0)GO TO 681
      NTOT=NTOT+1
      IYEAR(NTOT)=ITYEAR
      MONTH(NTOT)=ITMNTH
      IDAY(NTOT)=ITDAY
      IHOUR(NTOT)=IHRS
      MIN(NTOT)=IMIN
      ISEC1(NTOT)=ISEC
      ISEC2(NTOT)=IMSEC
      AZ(NTOT)=XAZ
      EL(NTOT)=ELVF
      RANG(NTOT)=RNGF
      ISPRI(NTOT)=NUMPRI
      IF(NTOT.EQ.4000)GO TO 121
      GO TO 118
  681 IF(ITLOSE.NE.0)GO TO 117
      WRITE(6  ,645)ALC,ITYEAR,ITMNTH,ITDAY,IHRS,IMIN,ISEC,IMSEC,IZERO,
     1XAZ,ELVF,RNGF,RZCT,NUMPRI
  645 FORMAT(1X,A3,3X,6I2,'.',I5,1X,I1,F8.3,4X,F8.3,4X,F12.4,5X,F8.5,
     1I10)
      WRITE(7  ,644)ALC,ITYEAR,ITMNTH,ITDAY,IHRS,IMIN,ISEC,IMSEC,IZERO,
     1XAZ,ELVF,RNGF
  644 FORMAT(A3,3X,6I2,'.',I5,1X,I1,F8.3,4X,F8.3,4X,F12.4,5X,F8.5)
      GO TO 118
  117 WRITE(6  ,650)ALC,ITYEAR,ITMNTH,ITDAY,IHRS,IMIN,ISEC,IMSEC,IZERO,
     1XAZ,ELVF,RNGF,RZCT,NUMPRI
  650 FORMAT(1X,A3,3X,6I2,'.',I3,1X,I1,F8.3,4X,F8.3,4X,F12.4,5X,F8.5,
     1 I10)
      WRITE(7  ,649)ALC,ITYEAR,ITMNTH,ITDAY,IHRS,IMIN,ISEC,IMSEC,IZERO,
     1XAZ,ELVF,RNGF
  649 FORMAT(A3,3X,6I2,'.',I3,3X,I1,F8.3,4X,F8.3,4X,F12.4,5X,F8.5)
C
  118 IF(NUMPRI.LT.NSTOP(IJ))GO TO 3
      IPULS=0
      IFRST1=0
  119 IFRST3=0
  120 CONTINUE
C
  121 IF(NINT.NE.0)GO TO 125
      NUSE=MSVE+1
      WRITE(6,128)NTOT,DTIME,NUSE
```

```
  128 FORMAT('OREADY TO SMOOTH',I6,'   POINTS WITH A DELTA TIME(SEC) = '
     1,F6.3,'  THEN PUNCH EVERY ',I6)
      WRITE(6,647)
      NCARDS=NTOT
      CALL SMOOTH(NSMOO,NCARDS,RANG,0,DTIME)
      ITESS=-1
      DO 6 I=1,NCARDS
      ITESS=ITESS+1
      IF(ITLOSE.EQ.0)GO TO 704
      IF(MOD(ITESS,NUSE).NE.0)GO TO 6
      WRITE(6,650)ALO,IYEAR(I),MONTH(I),IDAY(I),IHOUR(I),MIN(I),ISEC1(I)
     1,ISEC2(I),IZERO,AZ(I),EL(I),RANG(I),RR(I),ISPRI(I)
      WRITE(7,649)ALO,IYEAR(I),MONTH(I),IDAY(I),IHOUR(I),MIN(I),ISEC1(I)
     1,ISEC2(I),IZERO,AZ(I),EL(I),RANG(I),RR(I)
      GO TO 6
  704 CONTINUE
      IF(MOD(ITESS,NUSE).NE.0)GO TO 6
      WRITE(6,645)ALO,IYEAR(I),MONTH(I),IDAY(I),IHOUR(I),MIN(I),ISEC1(I)
     1,ISEC2(I),IZERO,AZ(I),EL(I),RANG(I),RR(I),ISPRI(I)
      WRITE(7,644)ALO,IYEAR(I),MONTH(I),IDAY(I),IHOUR(I),MIN(I),ISEC1(I)
     1,ISEC2(I),IZERO,AZ(I),EL(I),RANG(I),RR(I)
    6 CONTINUE
C
      GO TO 125
  103 WRITE(6,107)NUMPRI
  107 FORMAT('OPARITY ERROR ON READ AFTER PRI = ',I10)
      GO TO 99
  680 WRITE(6,109)NUMPRI
  109 FORMAT(' END OF FILE REACHED LAST NUMPRI VALUE = ',I10)
      GO TO 125
  6(5 WRITE(6,114)NBAND,ITBAND
  114 FORMAT(' INPUT BAND= 'I10,'   BAND ON TAPE = 'I10)
  125 RETURN
      END
```

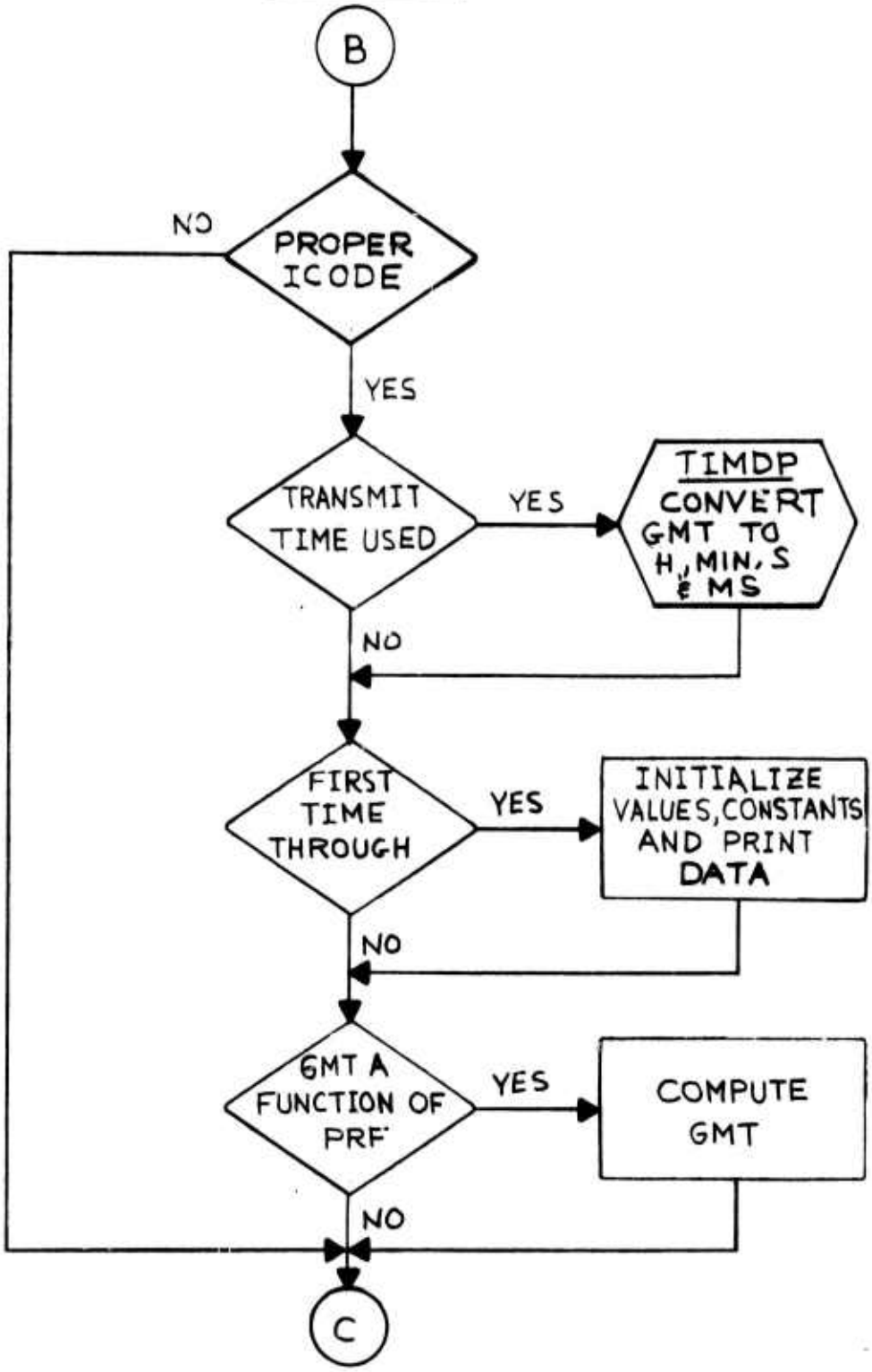
APPENDIX D
ALCPOD FLOW DIAGRAM



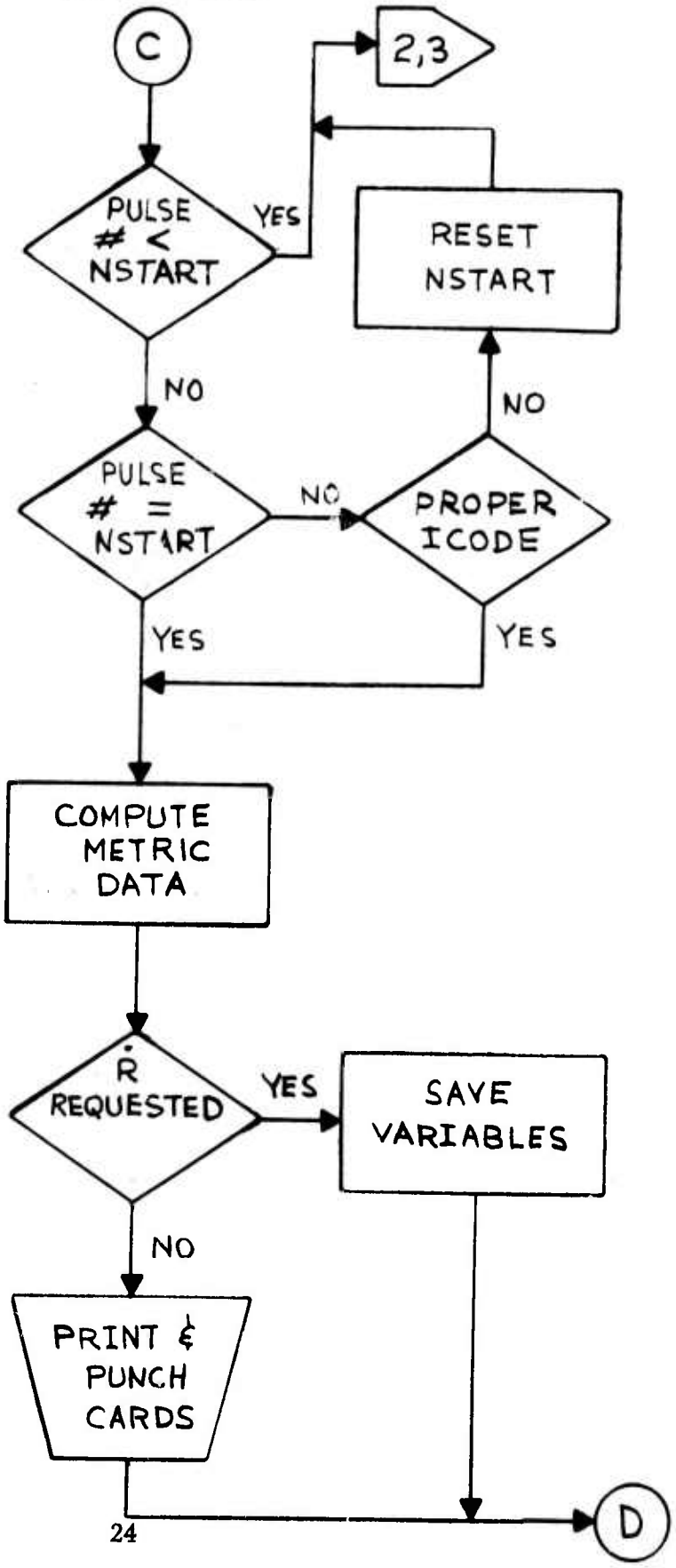
APPENDIX D-2


A
5,27
27
SET FIRST PROCESSING INTERVAL
4,3
5,3
3
TIME TO READ A NEW RECORD
NO
YES
READJS
READ A NEW RECORD
INCREASE RECORD COUNTER
ERROR MESSAGE
YES
PARITY ERROR
NO
UNPACK
UNPACK A PULSE
B

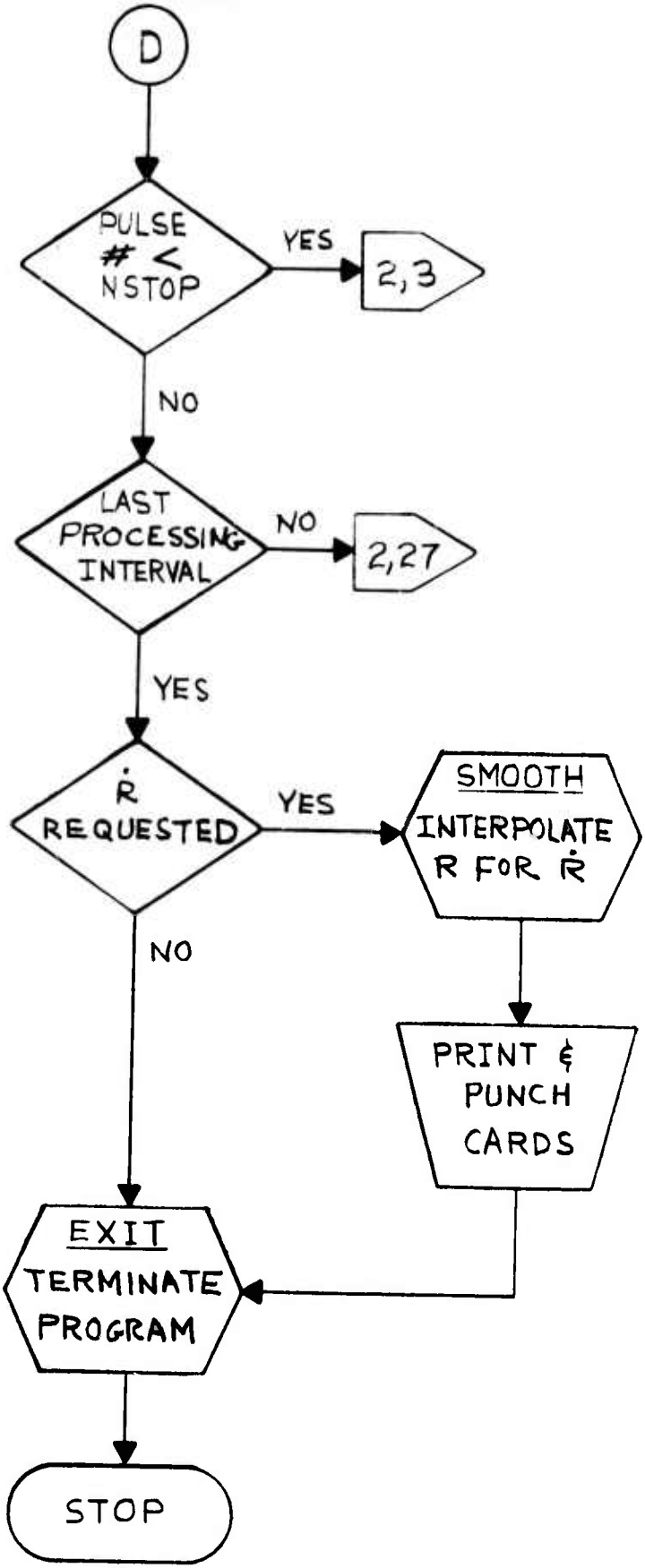
APPENDIX D-3


B
PROPER ICODE
NO
YES
TRANSMIT TIME USED
YES
TIMDP
CONVERT GMT TO H, MIN, S & MS
NO
FIRST TIME THROUGH
YES
INITIALIZE VALUES, CONSTANTS AND PRINT DATA
NO
GMT A FUNCTION OF PRF
YES
COMPUTE GMT
NO
C

APPENDIX D-4


C
2,3
PULSE # < NSTART
YES
RESET NSTART
NO
NO
PULSE # = NSTART
NO
PROPER ICODE
YES
YES
COMPUTE METRIC DATA
Ṙ REQUESTED
YES
SAVE VARIABLES
NO
PRINT & PUNCH CARDS
D

APPENDIX D-5


D
PULSE # < NSTOP
YES
2,3
NO
LAST PROCESSING INTERVAL
NO
2,27
YES
Ṙ REQUESTED
YES
SMOOTH
INTERPOLATE R FOR Ṙ
NO
PRINT & PUNCH CARDS
EXIT
TERMINATE PROGRAM
STOP

APPENDIX E
SUBROUTINE HEDADT PROGRAM LISTING

```
*
*               CALL HEDADT (ISIG,INBUF,IEQU)
*               ISIG = 1    UNPACK THE 20 WORD ADT HEADER
            START
            ENTRY HEDADT
            SPACE
XISIG       EQU   4
XICAL       EQU   5
XIEQU       EQU   6
BASE        EQU   12
            SPACE
HEDADT      SAVE  (14,12),T,*
            BALR  12,0
            USING *,BASE
            ST    13,SAVEA+4
            LA    7,SAVEA
            ST    7,8(0,13)
            LR    13,7
            SPACE
            LM    XISIG,XIEQU,0(1)
            SPACE
            L     8,0(XICAL)
            ST    8,TEMP1
            ST    8,TEMP2
            SRL   8,31
            ST    8,0(XIEQU)      MRANC
            L     8,TEMP1
            SLL   8,1
            SRL   8,25
            ST    8,4(XIEQU)      MREEL
            SPACE
            L     8,4(XICAL)
            ST    8,TEMP1
            ST    8,TEMP2
            SRL   8,16
            ST    8,8(XIEQU)      MHTR
            L     8,TEMP1
            SLL   8,16
            SRL   8,24
            ST    8,12(XIEQU)     MMNTH
            L     8,TEMP2
            SLL   8,24
            SRL   8,24
            ST    8,16(XIEQU)     MDAY
            SPACE
            SR    8,8
            IC    8,8(XICAL)
            ST    8,20(XIEQU)     MYEAR
            MVC   24(9,XIEQU),9(XICAL)    MISSION DES.
            SPACE
RETURN      L     13,SAVEA+4
            RETURN (14,12),T
            CNOP  0,4
TEMP1       DC    F'0'
TEMP2       DC    F'0'
SAVEA       DC    18A(*)
            END
```

APPENDIX F
SUBROUTINE UNPACK PROGRAM LISTING

```
          CSECT
          ENTRY UNPACK
UNPACK    SAVEL
          DROP  15
          CNOP  0,4
          BALR  2,0
          USING START,2,3
START     L     3,BASA
          L     4,DUBUF
          L     5,DUBUF
          L     6,DUBUF
          A     5,=F'4096'
          A     6,=F'8192'
          USING DBUF,4,5,6
          B     START1
DUBUF     DC    V(ICOM)
BASA      DC    A(START+4096)
START1    LA    8,INBUF   NUMPRI=8*(NPR-1)+JCON
          MVC   TEMP(3),0(8)
          MVC   TEMP2(3),0(8)
          L     9,TEMP
          SLL   9,8
          SRL   9,16
          S     9,ONE
          SR    8,8
          M     8,EIGHT
          A     9,JCON
          ST    9,NUMPRI
          L     9,NBEG
          C     9,NUMPRI
          BH    CDELTAR
          SPACE
          LA    8,WD273
          A     8,INDEX
          MVC   TEMP(3),0(8)
          L     9,TEMP
          N     9,=X'F0000000'
          SRL   9,28
          ST    9,ICODE                 COMPUTE THE CODE FOR PRI
          C     9,THREE                 SLAVED OR NOT
          BE    CDELTAR
          C     9,SEVEN
          BE    CDELTAR
          C     9,TWO
          BE    CDELTAR
          L     9,TEMP
          N     9,=X'08000000'
          SRL   9,27
          ST    9,I273B5                WBS MODE INDICATOR
          L     9,TEMP
          N     9,=X'04000000'
          SRL   9,26
          ST    9,I273B6                ENDO-EXO SCAN INDICATOR
          L     9,TEMP
          N     9,=X'02000000'
          SRL   9,25
          ST    9,I273B7                WBS SCAN MODE INDICATOR
```

```
          SPACE
          L       9,TEMP
          N       9,=X'01000000'
          SRL     9,24
          ST      9,I27BB8                    DOUBLET MODE INDICATOR
          L       9,TEMP
          N       9,=X'00100000'
          SRL     9,20
          ST      9,I27B12                    NB/WB INDICATOR
          SPACE
GOODI     LA      8,WD233  COMPUTE GMT
          A       8,INDEX
          MVC     TEMP(3),0(8)
          L       9,TEMP
          N       9,=X'1FC00000'
          SRL     9,24
          ST      9,IHRS                       STORE HRS
          L       9,TEMP
          N       9,=X'003F0000'
          SRA     9,16
          ST      9,IMIN                       STORE MINS
          L       9,TEMP
          N       9,=X'00003F00'
          SRA     9,8
          ST      9,ISEC                       STORE SECS
          LA      8,WD234
          A       8,INDEX
          MVC     TEMP(3),0(8)
          L       9,TEMP
          N       9,=X'7FE00000'
          SRL     9,21
          ST      9,IMSEC                      STORE MSEC
          L       8,NSW
          C       8,ZERO
          BNE     S9
          SR      8,8
          SR      9,9
          LA      8,WD275
          A       8,INDEX
          MVC     TEMP(3),0(8)
          L       8,TEMP
          LA      9,WD276
          A       9,INDEX
          MVC     TEMP(3),0(9)
          L       9,TEMP
          SLL     9,1
          SLL     8,1
          SRL     8,9
          SRDL    8,6
          ST      9,FLMASK+4
          ST      8,FLMASK
          MVI     FLMASK,X'46'
          LD      0,FLMASK
          AD      0,DZERO
          STD     0,XDPTIM
          SPACE
S9        LA      8,WD264                     PRF CALCULATION
```

```
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         ST     9,WCRD64
         LA     8,WD273
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         ST     9,WCRD73
         L      9,WCRD64
         N      9,=X'FFFFE000'
         SRL    9,13
NZSTMP   ST     9,STEMP
         L      9,=F'10000000'
         SR     8,8
         D      8,STEMP
         ST     9,STEMP                  TRANSMITTED PRF
         SPACE
         L      9,INBUF
         SRL    9,31
         C      9,ZERO
         BNE    WBAND
         SPACE
         L      9,WCRD73                 IN NARROW BAND
         N      9,=X'01000000'           BIT 8
         SRL    9,24
         C      9,ZERO
         BE     SLVDUB1
         SPACE
XDIV     L      8,FOUR                   IN DOUBLET MODE
XDIV1    ST     8,DIVSR
         B      NEWPRF
         SPACE
SLVDUB1  L      9,WCRD73
         N      9,=X'08000000'           BIT 5
         SRL    9,27
         C      9,ZERO
         BE     NBNWBN
         B      XDIV                     IN SLAVED DOUBLET MODE
NBNWBN   L      9,WCRD73
         N      9,=X'00100000'           BIT 12
         SRL    9,20
         C      9,ZERO
         BE     NODIVS
         L      8,TWO
         B      XDIV1                    NB/WB E.O.P.
NODIVS   L      8,ONE
         B      XDIV1                    NB ONLY
         SPACE
WBAND    L      9,WCRD73
         N      9,=X'01000000'           BIT 8
         SRL    9,24
         C      9,ZERO
         BNE    SLVDUB2
         L      8,TWO                    IN DOUBLET MODE
         B      XDIV1
SLVDUB2  L      9,WCRD73
```

```
         N      9,=X'08000000'          BIT 5
         SRL    9,27
         C      9,ZERO
         BNE    XDIV                    IN SLAVED DOUBLET MODE
         L      8,TWO
         B      XDIV1                   WB ONLY
         SPACE
NEWPRF   SR     8,8
         L      9,STEMP
         D      8,DIVSR
         ST     9,IPRF
         SPACE
NEXTW    LA     8,WD237
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'7FFFC000'
         SRL    9,14
         ST     9,IAZ
         LA     8,WD236                 STORE AZ
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'7FFFCCCO'
         SRL    9,14
         ST     9,IEL
GOCON    LA     8,WD265                 STORE ELEV
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'FFFFE000'
         SRL    9,13
         ST     9,TEMP2
         LA     8,WD267
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'FFFF0C00'
         SRL    9,16
         A      9,TEMP2
         SLL    9,11
         ST     9,TEMP2
         LA     8,WD266
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'FFE00C00'
         SRL    9,21
         A      9,TEMP2
         ST     9,IRANGE                STORE RANGE
         LA     8,WD115
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'00FFC000'
         SRA    9,16
         ST     9,IPKPWR                STORE PEAK POWER
```

```
         LA    8,WD269
         A     8,INDEX
         MVC   TEMP(3),0(8)
         L     9,TEMP
         C     9,=F'0'
         BNL   DOTG1
         N     9,=X'7FF5FF00'
         SRA   9,8
         LCR   9,9
         B     DOTG2
DOTG1    SRA   9,8
DOTG2    ST    9,IRDCT                    STORE R-DCT
         SPACE
         LA    8,WD117
         A     8,INDEX
         MVC   TEMP(3),0(8)
         L     9,TEMP
         N     9,=X'FFC00000'
         SRL   9,24
         ST    9,IMOVP                    ARE PRIMARY AND OFFSET MOVING
         SPACE
         L     9,TEMP
         N     9,=X'0CC0FF00'
         SRL   9,8
         ST    9,IMOVO                    IS OFFSET WINDOW MOVING
         SR    9,9
         ST    9,ICFFST
         L     9,ICODE
         C     9,THREE
         BE    OFFCOM
         C     9,SEVEN
         BE    OFFCOM
         B     OFFSKP
         SPACE
OFFCOM   LA    8,WD278
         A     8,INDEX
         MVC   TEMP(3),0(8)
         SR    9,9
         L     9,TEMP
         C     9,ZERO
         BNL   RPLUS
         N     9,=X'7FFFFF00'
         SRA   9,8
         LCR   9,9
         B     RNEG
RPLUS    SRA   9,8
RNEG     ST    9,ICFFST                   RANGE OFFSET FOR SLAVED WINDOW
         SPACE
OFFSKP   LA    8,WD263
         A     8,INDEX
         MVC   TEMP(3),0(8)
         L     9,TEMP
         N     9,=X'F0C00000'
         SRL   9,26
         LA    11,PIFA
         LE    0,0(9,11)                  GET VALUE FROM PIFA TABLE
         STE   0,XPPAGC
```

```
         L     9,TEMP
         N     9,=X'0FC00000'
         SRL   9,22
         LA    11,OIFA
         LE    0,0(9,11)              GET VALUE FROM OIFA TABLE
         STE   0,XOPAGC
         L     9,ZERO
         ST    9,ISWSSP
         ST    9,ISWSSC
         ST    9,ISSERR
         LA    8,WD239
         A     8,INDEX
         MVC   TEMP(3),0(8)
         L     9,TEMP
         N     9,=X'00000200'         CHECK BIT 23 (PFSA)
         C     9,ZERO
         BE    CKFSOP
         LE    0,PFSA
         AE    0,XPPAGC
         STE   0,XPPAGC               ADD IN PFSA VALUE
CKFSOP   L     9,TEMP
         N     9,=X'00000100'         CHECK BIT 24 (OFSA)
         C     9,ZERO
         BE    CKSSPP
         LE    0,OFSA
         AE    0,XOPAGC
         STE   0,XOPAGC               ADD IN OFSA VALUE
CKSSPP   L     11,TEMP
         N     11,=X'00802C00'
         C     11,=F'0'
         BNE   CKSSOP
INDET    L     8,ONE                  INDETERMINATE SITUATION
         ST    8,ISSERR
         B     CCELTAR
CKSSOP   L     11,TEMP
         N     11,=X'0C4C1000'
         C     11,=F'0'
         BE    INDET
PPTEST   LA    9,WD239
         A     9,INDEX
         MVC   TEMP(3),0(9)
         L     10,TEMP                AUX.MICR.WORD INTO REG.10
         LA    9,WD252                AUX.MICROWAVE WORD INTO REG.11
         A     9,INDEX
         MVC   TEMP(3),0(9)
         L     11,TEMP
         LA    9,WD272
         A     9,INDEX
         MVC   TEMP(3),0(9)           RANGE TR.WORD INTO TEMP
         N     10,=X'0C802000'
         C     10,=X'00800000'
         BNE   S74
         LE    0,PSSL                 ADD IN PSSL (COND.8)
         AE    0,XPPAGC
         STE   0,XPPAGC
         L     9,ONE
         ST    9,ISWSSP
```

```
S74       L     8,NEWA                    OLD OR NEW ATTEN.
          C     8,ZERO
          BE    OPTEST
          L     9,TEMP
          N     9,=X'00080000'
          C     9,=F'0'
          BE    RDBKLC                    ATTENUATOR READBACK
          N     11,=X'08000000'           S74 ARMED
          C     11,ZERO                   STATUS READ BACK
          BNE   SLC
NOATTLC   LE    0,PREVLC
          STE   0,XPPAGC
          MVC   JSWLC(4),ONE
          MVC   ISSERR(4),ONE
          B     OPTEST
RDBKLC    N     11,=X'04000000'           S74 NOT ARMED
          C     11,ZERO                    STATUS READBACK
          BE    NOATTLC
          B     OPTEST
SLC       LE    0,PSSA
          AE    0,XPPAGC                  ADD IN PSSA (COND.B)
STORLC    STE   0,XPPAGC
          MVC   ISWSSP(4),ONE
OPTEST    LA    9,WD239
          A     9,INDEX
          MVC   TEMP(3),0(9)
          L     10,TEMP                   AUX.MICR.WORD INTO REG.10
          LA    9,WD252                   AUX.MICROWAVE WORD INTO REG.11
          A     9,INDEX
          MVC   TEMP(3),0(9)
          L     11,TEMP
          LA    9,WD272
          A     9,INDEX
          MVC   TEMP(3),0(9)              RANGE TR.WORD INTO TEMP
          N     10,=X'004C1000'
          C     10,=X'004C0000'
          BNE   S75
       LE       0,OSSL                    ADD IN OSSL (COND.B)
          AE    0,XOPAGC
          STE   0,XOPAGC
          L     9,ONE
          ST    9,ISWSSC
S75       L     8,NEWA                    OLD OR NEW ATTEN.
          C     8,ZERO
          BE    OUT1
          L     9,TEMP
          N     9,=X'00C4C000'
          C     9,=F'0'
          BE    RDBKRC                    ATTENUATOR READBACK
          N     11,=X'02000000'           S75 ARMED
          C     11,ZERO                   STATUS READ BACK
          BNE   SRC
NOATTRC   LE    0,PREVRC
          STE   0,XOPAGC
          MVC   JSWRC(4),ONE
          MVC   ISSERR(4),ONE
          B     OUT1
```

```
RDBKRC   N      11,=X'01000000'      S75 NOT ARMED
         C      11,ZERO               STATUS READBACK
         BE     NOATTRC
         B      CUT1
SRC      LE     0,OSSA
         AE     0,XOPAGC             ADD IN OSSA (COND.B)
STCRCC   STE    0,XOPAGC
         MVC    ISWSSC(4),ONE
CUT1     L      9,JSWLC
         C      9,ZERO
         BNE    OUT2
         LE     0,XPPAGC
         SE     0,=E'16'
         STE    0,XPPAGC
         STE    0,PREVLC
CUT2     L      9,JSWRC
         C      9,ZERO
         BNE    ENDALERT
         LE     0,XOPAGC
         SE     0,=E'16'
         STE    0,XOPAGC
         STE    0,PREVRC
ENDALERT MVC    JSWLC(4),ZERO
         MVC    JSWRC(4),ZERO
         L      9,ITBAND             COMPUTE RANGE BIASES
         C      9,ZERO
         BE     NBAND
         LE     2,RBIAS+16           WIDE BAND TAPE
         STE    2,TRBIAS
         L      9,IPOLAR
         C      9,ZERO
         BE     LCPOLAR
         LE     2,RBIAS+20           OP POLARIZATION
         AE     2,TRBIAS             ADD WB CP BIAS
         STE    2,TRBIAS
         L      9,ISWSSC             ISWSSC WAS SET IN AGC COMP.
         C      9,ONE                =1,ADD 32 DB (OP)
         BNE    CDELTAR
         LE     2,RBIAS+28           ADD IN CPSSA- RBIAS(8)
         AE     2,TRBIAS
         STE    2,TRBIAS
         B      CDELTAR
LCPOLAR  L      9,ISWSSP
         C      9,ONE
         BNE    CDELTAR
         LE     2,RBIAS+24
         AE     2,TRBIAS             ADD IN PSSA-RBIAS(7)
         STE    2,TRBIAS
         B      CDELTAR
NBAND    LE     2,RBIAS              NARROW BAND
         STE    2,TRBIAS
         LA     8,WD273              CENTER OR EDGE TRACK
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'00010000'
         C      9,ZERO
```

```
          BNE    CKNBEDGE                EDGE TRACKING
          B      CKPOLAR                 CENTER TRACK
CKNBEDGE  L      8,IRDOT                 CHECK SIGN OF R DOT
          C      8,ZERO
          BH     CKNBLOW
          LE     2,RBIAS+4               LEADING EDGE BIAS
          AE     2,TRBIAS
          STE    2,TRBIAS
          B      CKPOLAR
CKNBLOW   LE     2,RBIAS+8               TRAILING EDGE BIAS
          AE     2,TRBIAS
          STE    2,TRBIAS
CKPOLAR   L      9,IPOLAR                CHECK POLARIZATION DESIRED
          C      9,ZERO
          BE     CDELTAR
          LE     2,RBIAS+12              ADD NP OP BIAS
          AE     2,TRBIAS
          STE    2,TRBIAS
CDELTAR   RETL
TEMP      DC     F'0'
TEMP2     DC     F'0'
IXC       DC     F'0'
NPTAPE    DC     F'0'
PRINUM    DC     F'0'
IPASS     DC     F'0'
ISWSSO    DC     F'0'
ISWSSP    DC     F'0'
DIVSR     DC     F'0'
WORD64    DC     F'0'
WORD73    DC     F'0'
STEMP     DC     F'0'
PREVLC    DC     E'0.0'
PREVRC    DC     E'0.0'
JSWLC     DC     F'0'
JSWRC     DC     F'0'
ZERO      DC     F'0'
ONE       DC     F'1'
TWO       DC     F'2'
THREE     DC     F'3'
FOUR      DC     F'4'
SEVEN     DC     F'7'
EIGHT     DC     F'8'
TEN       DC     F'10'
C100      DC     F'100'
C1000     DC     F'1000'
DZERO     DC     D'0.0'
FLMASK    DC     X'4600000000000000'
DBUF      DSECT
INBUF     DS     CL3
WD1       DS     CL3          PP LOG D.
          DS     CL48
WD18      DS     CL3
WD19      DS     CL3
          DS     CL27
WD29      DS     CL3
WD30      DS     CL3
          DS     CL81
```

```
WD58      DS    CL171     PP PHASE D.
WD115     DS    CL3
WD116     DS    CL3
WD117     DS    CL3
WD118     DS    CL171     OP LOG D.
WD175     DS    CL171     OP PHASE D.
WD232     DS    CL3
WD233     DS    CL3
WD234     DS    CL3
          DS    CL3
WD236     DS    CL3
WD237     DS    CL3
          DS    CL3
WD239     DS    CL3
WD240     DS    CL3
WD241     DS    CL3
WD242     DS    CL3
          DS    CL27
WD252     DS    CL3
WD253     DS    CL3
          DS    CL27
WD263     DS    CL3
WD264     DS    CL3
WD265     DS    CL3
WD266     DS    CL3
WD267     DS    CL3
WD268     DS    CL3
WD269     DS    CL3
WD270     DS    CL3
WD271     DS    CL3
WD272     DS    CL3
WD273     DS    CL3
WD274     DS    CL3
WD275     DS    CL3
WD276     DS    CL3
WD277     DS    CL3
WD278     DS    CL3
WD279     DS    CL3
WD280     DS    CL3
          DS    CL6369
IAZ       DS    1F
IEL       DS    1F
INDEX     DS    1F
IPPRCS    DS    1F
IORS      DS    1F
IRANGE    DS    1F
IPKPWR    DS    1F
IRDOT     DS    1F
IALT      DS    1F
INDAZ     DS    1F
JNDAZ     DS    1F
INDEL     DS    1F
IRB54     DS    1F
IRB85     DS    1F
IOPRCS    DS    1F
I240B1    DS    1F
I240B2    DS    1F
I240B3    DS    1F
I241B1    DS    1F
I241B2    DS    1F
```

```
I241B3    DS    1F
XPPAGC    DS    1F
IBETA     DS    1F
NEWA      DS    1F
BAND      DS    1F
NSW       DS    1F
RBIAS     DS    8F
ISVPRI    DS    1F
IHRS      DS    1F
IMIN      DS    1F
ISEC      DS    1F
IMSEC     DS    1F
STAT      DS    21F
TRBIAS    DS    1F
ISTAT1    DS    1F
ISTAT2    DS    1F
ISTAT3    DS    1F
ISTAT4    DS    1F
IALSW     DS    1F
ISTSW     DS    1F
NBWB      DS    1F
ISIGNO    DS    1F
I27812    DS    1F
JCCN      DS    1F
NBEG      DS    1F
NEND      DS    1F
ITST      DS    1F
NUMPRI    DS    1F
XOPAGC    DS    1F
ITBAND    DS    1F
ITAPNO    DS    1F
IPRF      DS    1F
IPOLAR    DS    F
ISSERR    DS    F
PIFA      DS    16F
CIFA      DS    16F
PFSA      DS    1F
CFSA      DS    1F
PSSA      DS    1F
CSSA      DS    1F
PSSL      DS    1F
CSSL      DS    1F
ICODE     DS    F
I27385    DS    F
I27386    DS    F
I27387    DS    F
I27388    DS    F
IMOVP     DS    F
IMOVC     DS    F
IOFFST    DS    F
XDPTIM    DS    D
IDAT      DS    682F
          END
```

APPENDIX G
SUBROUTINE TIMDP PROGRAM LISTING

```
      SUBROUTINE TIMDP(TIME,IHR,MIN,ISEC,IFRAC)
      DOUBLE PRECISION TIME,TIME2,XCON,FRAC
      DATA XCON/1000000.0/
      IX=TIME
      IHR=IX/3600
      MIN=MOD(IX,3600)/60
      ISEC=MOD(IX,60)
      TIME2=DFLOAT(IX)*XCON
      TIME=TIME*XCON
      FRAC=TIME-TIME2
      IFRAC=FRAC
      RETURN
      END
```

APPENDIX H

SUBROUTINE SMOOTH PROGRAM LISTING

```
      SUBROUTINE SMOOTH (N,L,X,NO,ZH)
C SMCOTH OS/360 DIMENSION RR,C1,VEL INCREASED TO  700          3DJUN67
CSMOOTH  OS/360    COMMON CHANGED AND ARGUMENTS AS WELL       12 JULY 66
CSMOCTH  OS/360                                               20 JUNE 66
CSMCCTH       DIMENSION REDUCED TO 500                         17 AUG 65
CSMOOTH                                                       24 MAY 65
C      SMOOTH REPLACES THE POSITION MEASUREMENT X(I) AT THE MIDPOINT OF
C      THE INTERVAL T(I-N)LESS THAN T LESS THAN T(I+N) BY THE CRDINATE
C      OF THE PARABOLA AT THAT POINT. THE SMCOTHED VALUE X(I) THUS
C      OBTAINED IS EXPRESSED AS A WEIGHTED AVERAGE OF THE MEASURED
C      VALUES. THE SLIDING PARABOLA TECHNIQUE CONSISTS MERELY OF
C     APPLYING THIS OPERATION TO EACH INTERVAL BETWEEN T(I-N)AND T(I+N),
C      SLIDING ONE POINT AT A TIME, AS I=N+1,N+2,...,L-N.
C     ZH,THE TIME INTERVAL BETWEEN POINTS
C      L,THE TOTAL NUMBER OF POINTS
C      N,THE NUMBER OF POINTS ON EACH SIDE OF X(I)
C      NO, A PARAMETER WHICH INDICATES WHETHER THAT WHICH IS BEING READ
C     IS POSITION, VELOCITY, OR ACCELERATION.
C      X(I), THE X-COORDINATE
C      Y(I), THE Y-COORDINATE
C      Z(I), THE Z-COORDINATE
      IMPLICIT REAL*8 (A-H,O-X)
      COMMON RR
      DIMENSION X(1),,RR(1)
C
      M=2*N+1
      S=M
      JC=N+1
      KO=L-N
      SQ=S*S
      H = ZH
    4 IF (NO) 5,10,20
C                    SET UP THE COEFFICIENTS FOR POSITION
    5 O=3.000/(4.000*S*(SQ-4.000))
      Q1 = SQ-4.000
      Q2 = 4.000*S
      Q3 = Q1*Q2
      Q4 =  3.000/Q3
      D2=D*D
      A = 3.000*SQ-7.000
      B=0.D
      C=-20.D
      GO TO 5757
C                    SET UP THE COEFFICIENTS FOR VELOCITY
   10 O=12.000/(H*S*(SQ-1.000))
      Q1 = SQ-1.000
      Q2 = H*S
      Q3 = Q1*Q2
      Q4 = 12.000/Q3
      D2=D*D
      A=0.0
      B=1.0
      C=0.D
      GO TO 5757
C                    SET UP T  COEFFICIENTS FOR ACCELERATION
   20 D=30.000/(H*H*S*(SQ-1.  *(SQ-4.000))
      D2=D*D
      A = 1.000-SQ
      B=0.D
      C=12.0
 5757 DO 500 I=JC,KO
      SUMX=A*X(I)
      DO 600 K=1,N
      J=I+K
      LIK = I - K
      T=K
      V = -2.000*B*T
      SUMX=SUMX+(A+B*T+C*T*T)*(X(J)+X(LIK))+V*X(LIK)
  600 CONTINUE
C                  FORM THE SMOOTHED VALUE FOR EACH COORDINATE
      ADJX=D*SUMX
   59 RR(I) = ADJX
  500 CONTINUE
  157 RETURN
      END
```

APPENDIX J

SUBROUTINE DREFC PROGRAM LISTING

```
      SUBROUTINE DREFC(E,R,DEE,DRR)          VERSION: 6/15/70
      IMPLICIT REAL * 8 (A-H,O-Z)
      DIMENSION CE(16,8),DR(16,8),ED(16),RD(8)
      DATA DE/0.0    ,0.0    ,0.0    ,0.0    ,0.0    ,0.0    ,0.0    ,0.0    ,
     10.0    ,0.0    ,0.0    ,0.0    ,0.0    ,0.0    ,0.0    ,0.0313,
     20.0303,0.0292,0.0287,0.0282,0.0272,0.0262,0.0253,0.0243,0.0223,
     30.0214,0.0195,0.0171,0.0135,0.0075,0.0    ,0.0937,0.0848,0.0770,
     40.0732,0.0694,0.0627,0.0571,0.0522,0.0480,0.0412,0.0385,0.0337,
     50.0278 0.0205,0.0105,0.0    ,0.1850,0.1520,0.1250,0.1140,0.1050,
     60.0904,0.0795,0.0708,0.0636,0.0523,0.0478,0.0405,0.0323,0.0229,
     70.0114,0.0    ,0.5310,0.3070,0.2120,0.1830,0.1600,0.1280,0.1060,
     80.0899,0.0780,0.0612,0.0550,0.0455,0.0354,0.0246,0.0120,0.0    ,
     90.7550,0.3720,0.2400,0.2020,0.1750,0.1370,0.1120,0.0942,0.0811,
     A0.0631,0.0566,0.0466,0.0361,0.0250,0.0122,0.0    ,0.9120,0.4110,
     B0.2560,0.2140,0.1840,0.1420,0.1150,0.0967,0.0830,0.0643,0.0575,
     C0.0472,0.0365,0.0252,0.0122,0.0    ,0.9700,0.4200,0.2600,0.2200,
     D0.1900,0.1460,0.1170,0.0980,0.0840,0.0653,0.0584,0.0478,0.0369,
     E0.0254,0.0123,0.0 /
      DATA DR/  0.0,  0.0,  0.0,  0.0,  0.0,  0.0,  0.0,  0.0,  0.0,
     1  0.0,  0.0,  0.0,  0.0,  0.0,  0.0,  0.0, 22.6, 21.5, 20.4, 19.9,
     2 19.4, 18.5, 17.6, 16.8, 16.1, 14.8, 14.2, 13.2, 12.0, 10.4,  8.6,
     3  7.7, 67.3, 57.9, 50.2, 47.0, 44.1, 39.3, 35.4, 32.1, 29.3, 24.8,
     4 22.9, 19.7, 16.3, 12.7,  9.4,  8.1,132.0, 98.5, 77.4, 69.7, 63.2,
     5 52.9, 44.7, 38.4, 33.4, 26.4, 23.9, 20.1, 16.4, 12.7,  9.4,  8.1,
     6340.0,167.0,103.0, 86.1, 73.4, 56.7, 46.2, 38.9, 33.6, 26.4, 24.0,
     7 20.2, 16.4, 12.8,  9.5,  8.2,405.0,170.0,104.0, 86.3, 73.6, 56.8,
     8 46.3, 38.9, 33.7, 26.5, 24.1, 20.3, 16.5, 12.8,  9.5,  8.2,421.0,
     9171.0,104.0, 86.6, 73.9, 57.1, 46.4, 39.0, 33.8, 26.8, 24.3, 20.5,
     A 16.6, 13.0,  9.8,  8.4,446.0,172.0,105.0, 87.4, 74.0, 58.0, 46.6,
     8 39.2, 34.0, 27.0, 24.6, 20.7, 16.7, 13.0, 10.0,  8.4/
      DATA EO,RTOEO/0.01,2.0,4.0,5.0,6.0,8.0,10.0,12.0,14.0,18.,20.,
     124.,30.,40.,60.,90.,57.29578/
      DATA RO/0.01,10.,30.,60.,200.,400.,1000.,2000./
      IF(R.LE.0.0)GO TO 300
      RG=R/1.8520+00
      DO 100 IEO=2,15
      I=17-IEO
      IF(E.GE.EO(I))GO TO 120
100   CONTINUE
      I=1
120   DO 200 JRO=2,8
      J=10-JRO
      IF(RG.GE.RO(J))GO TO 220
200   CONTINUE
      J=1
220   IF(J.EQ.8)GO TO 340
      ZR=DLOG(RG/RO(J))/DLOG(RO(J+1)/RO(J))
      IF(E.LE.0.0)GO TO 320
      ZE=DLOG(E/EO(I))/DLOG(EO(I+1)/EO(I))
      OE1=((DE(I+1,J)-DE(I,J))*(1.-ZR)+(DE(I,J+1)-DE(I,J))*ZR)*ZE
      OE2=((DE(I,J+1)-DE(I,J))*(1.-ZE)+(DE(I+1,J+1)-DE(I,J+1))*ZE)*ZR
      DEE=DE1+DE2+DE(I,J)
      DR1=((DR(I+1,J)-DR(I,J))*(1.-ZR)+(DR(I,J+1)-DR(I,J))*ZR)*ZE
      DR2=((DR(I,J+1)-DR(I,J))*(1.-ZE)+(DR(I+1,J+1)-DR(I,J+1))*ZE)*ZR
      DRR=(DR1+DR2+DR(I,J))
      GO TO 400
300   DEE=0.0
      DRR=0.0
      GO TO 400
320   DEE=DE(I,J)+(DE(I,J+1)-DE(I,J))*ZR
      DRR=DR(I,J)+(DR(I,J+1)-DR(I,J))*ZR
      GO TO 400
340   DELT=(E-ED(I))/(EO(I+1)-ED(I))
      DEE=DELT*(DE(I+1,J)-DE(I,J))+DE(I,J)
      DRR=DELT*(DR(I+1,J)-DR(I,J))+DR(I,J)
400   DRR=DRR*.3048D-03
      END
```